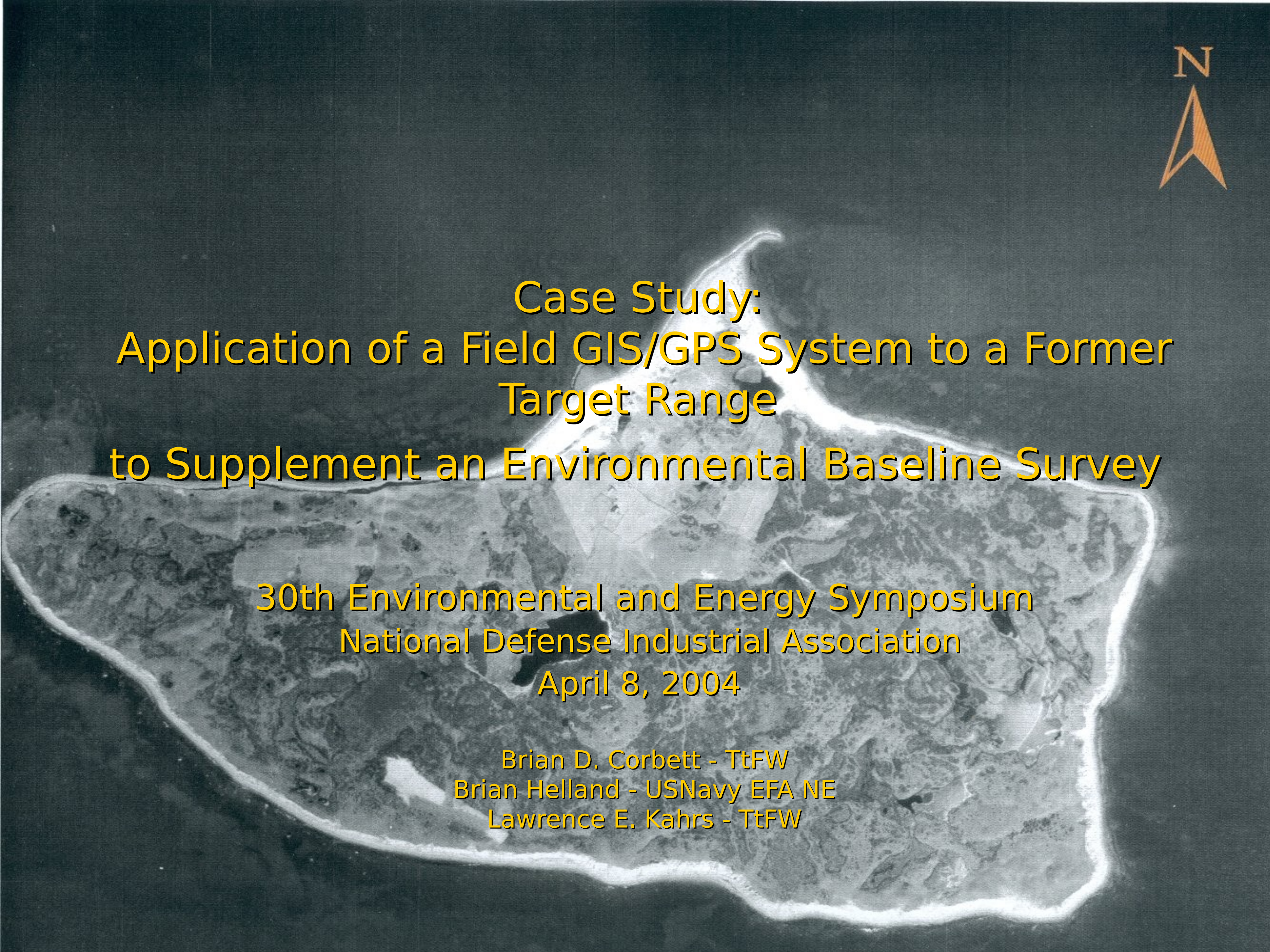


Case Study: Application of a Field GIS/GPS System to a Former Target Range to Supplement an Environmental Baseline Survey

30th Environmental and Energy Symposium
National Defense Industrial Association
April 8, 2004

Brian D. Corbett - TtFW
Brian Helland - USNavy EFA NE
Lawrence E. Kahrs - TtFW

Site Background

- **628 acre remote island in Atlantic Ocean, south of Martha's Vineyard, MA**
- **1942 to 1996 - aerial bombing, strafing, and rocket range**
- **1963 - live ordnance bombing ceased**
- **1997 - Navy transferred the island to the USFWS as part of the Great Meadows Wildlife Refuge - original Environmental Baseline Survey (EBS) is developed**
- **1998 - 2004 - extensive UXO surface clearance - UST removal/remediation - Phase I - Initial Site Investigation - Phase II - Comprehensive Site Assessment - Phase IIA - Stage II Ecological Risk Assessment - Supplemental Environmental Baseline Survey (SEBS)**

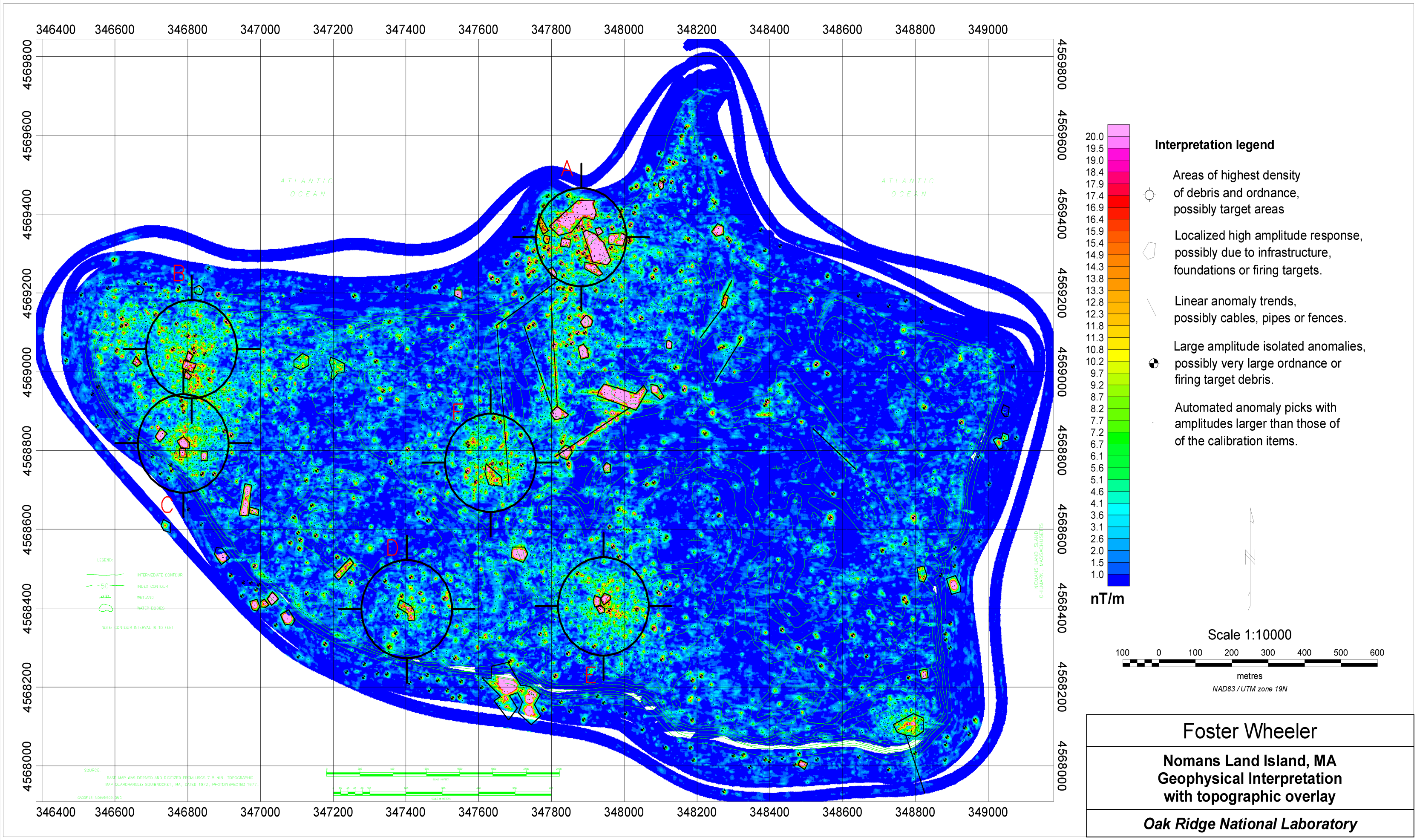
Supplemental Environmental Baseline Survey (SEBS) Program

- Aerial Photogramatic Survey
- Aerial Geophysical Survey
- Aerial Photographic Site Analysis
- Historical Design Drawings
- Archive Search Report for Military Documentation
- Public Interviews

SEBS Data

- **Aerial Photogramatic Survey**
  - **realized need for good base map**
  - **2001 - entire island flown for topography and digital orthometric quads**
  - **required 12 aerial targets to be surveyed on the island - problem was there was no good first-order control point**
  - **final product tested accurate to +/- 1 meter**
- **Aerial Geophysical Survey**
  - **entire Island and nearshore coastline was flown**
  - **helicopter equipped with magnetometers flying at 2-3 meters**
  - **areas of subsurface metallic debris remaining would later help confirm the Conceptual Site Model (CSM)**

Airborne Geophysical Survey


346400
346600
346800
347000
347200
347400
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347800
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348200
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348600
348800
349000
4569800
4569600
4569400
4569200
4569000
4568800
4568600
4568400
4568200
4568000
A
B
C
D
E
ATLANTIC OCEAN
ATLANTIC OCEAN
20.0
19.5
19.0
18.4
17.9
17.4
16.9
16.4
15.9
15.4
14.9
14.3
13.8
13.3
12.8
12.3
11.8
11.3
10.8
10.2
9.7
9.2
8.7
8.2
7.7
7.2
6.7
6.1
5.6
5.1
4.6
4.1
3.6
3.1
2.6
2.0
1.5
1.0
nT/m
Interpretation legend
Areas of highest density of debris and ordnance, possibly target areas
Localized high amplitude response, possibly due to infrastructure, foundations or firing targets.
Linear anomaly trends, possibly cables, pipes or fences.
Large amplitude isolated anomalies, possibly very large ordnance or firing target debris.
Automated anomaly picks with amplitudes larger than those of the calibration items.
N
Scale 1:10000
100
0
100
200
300
400
500
600
metres
NAD83 / UTM zone 19N
Foster Wheeler
Nomans Land Island, MA
Geophysical Interpretation
with topographic overlay
Oak Ridge National Laboratory

TETRA TECH FW, INC.

SEBS Data (continued)

- Aerial Photographic Site Analysis
  - needed to establish a time-line for military related activities
  - all available historical aerial photographs were researched
  - 22 were found 1942 - 1999
  - most useful piece of new data within the SEBS
  - final product identified new areas of concern but aided to confirm CSM
- Historical Design Drawings
  - needed to exhaust all efforts to provide historical use timeline
  - Records Review - NAS
  - 10 design drawings - 1944 - 1958
  - scanned, digitized, and geo-referenced
  - final product provided accurate spatial locations for new areas of concern

Aerial Photographic Site Analysis

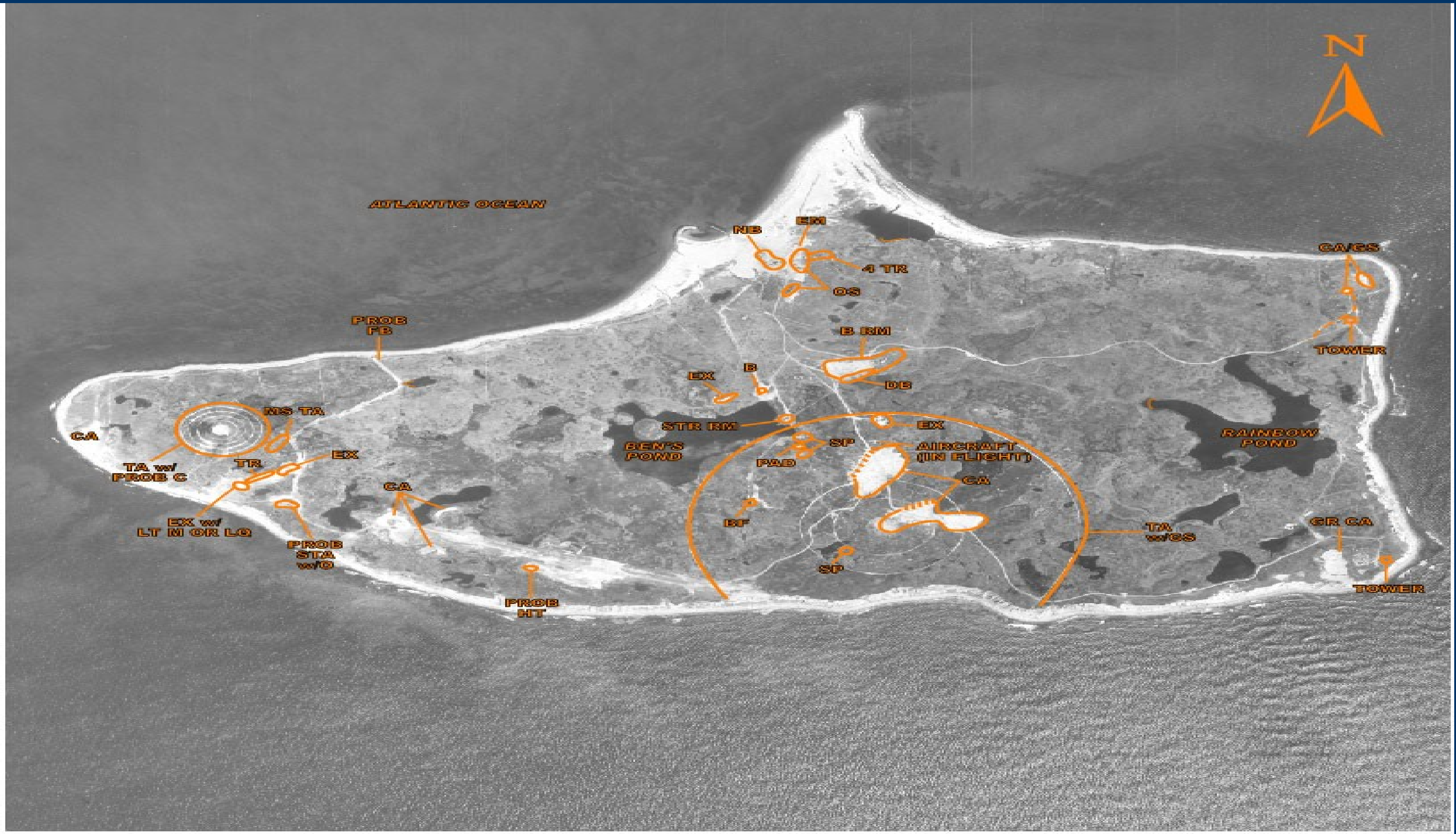
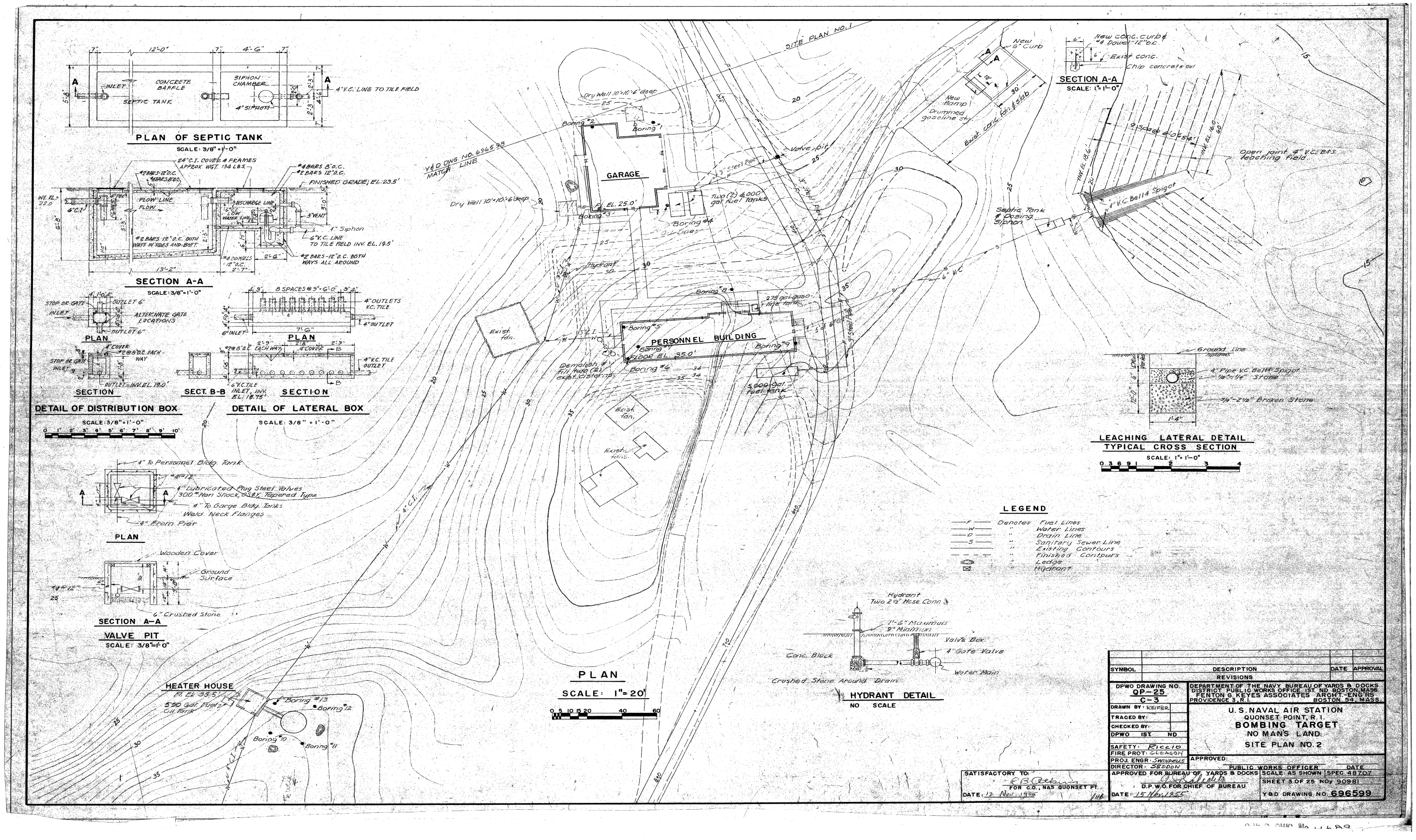

N
ATLANTIC OCEAN
NB
EM
4 TR
OS
CA/GS
PROB FB
B RM
EX
B
DB
TOWER
MS TA
CA
STR RM
EX
BEN'S POND
SP
PAD
AIRCRAFT (IN FLIGHT)
RAINBOW POND
TA w/ PROB C
TR
EX
CA
CA
EX w/ LT M OR LQ
PROB STA w/O
BF
TA w/GS
GR CA
SP
TOWER
PROB HT

FIGURE 6
NOMANS LAND ISLAND
APRIL 22, 1957
APPROX. SCALE 1:11,800
1"=983'

Adapted from Environmental Research Inc., Figure 6 - Aerial Photographic Site Analysis Report, dated 2/2002.

TETRA TECH FW, INC.

Historical Design Drawings


PLAN OF SEPTIC TANK
SCALE: 3/8"=1'-0"
SECTION A-A
SCALE: 3/8"=1'-0"
DETAIL OF DISTRIBUTION BOX
SCALE: 3/8"=1'-0"
DETAIL OF LATERAL BOX
SCALE: 3/8"=1'-0"
VALVE PIT
SCALE: 3/8"=1'-0"
HEATER HOUSE
GARAGE
PERSONNEL BUILDING
SITE PLAN NO. 1
PLAN
SCALE: 1"=20'
LEACHING LATERAL DETAIL
TYPICAL CROSS SECTION
SCALE: 1"=1'-0"
HYDRANT DETAIL
NO SCALE
LEGEND
Denotes Fuel Lines
Water Lines
Drain Line
Sanitary Sewer Line
Existing Contours
Finished Contours
Ledge
Hydrant
SYMBOL
DESCRIPTION
DATE
APPROVAL
REVISIONS
DPWO DRAWING NO.
QP-25
C-3
DEPARTMENT OF THE NAVY BUREAU OF YARDS & DOCKS
DISTRICT PUBLIC WORKS OFFICE 1ST. ND BOSTON, MASS.
FENTON G. KEYES ASSOCIATES ARCHT.-ENG'RS
PROVIDENCE 3, R.I. BOSTON 54, MASS.
DRAWN BY: KEIFER
TRACED BY:
CHECKED BY:
DPWO 1ST ND
SAFETY: Riccio
FIRE PROT: GLEASON
PROJ. ENGR: SWINDELLS
DIRECTOR: SEDDON
U.S. NAVAL AIR STATION
QUONSET POINT, R.I.
BOMBING TARGET
NO MAN'S LAND
SITE PLAN NO. 2
APPROVED:
PUBLIC WORKS OFFICER
DATE
SATISFACTORY TO:
FOR C.O., NAS QUONSET PT.
DATE: 12 Nov 1955
APPROVED FOR BUREAU OF YARDS & DOCKS
D.P.W.O. FOR CHIEF OF BUREAU
DATE: 15 Nov. 1955
SCALE: AS SHOWN
SPEC. 48707
SHEET 3 OF 25 NOy 90981
Y&D DRAWING NO. 696599

TETRA TECH FW, INC.

SEBS Planning

- needed a way to manage the data and easily present it to the TRC and the public…..

- Geographic Information System (GIS)

•Layer 1	Aerial Photogrametric Base Map - Ortho Image geo-referenced .TIFF
•Layer 2	Airborne Geophysical Data geo-referenced .JPEG
•Layer 3	Aerial Photographic Site Analysis .shp files (points, lines, and polygons)
•Layer 4	Historical Design Drawings .dxf & .shp files (points, lines, and polygons)
•Layer 5	6 years worth of sampling locations/chemical data

- Other Layers
  - 1998 clearance grids
  - 3/D analysis

SEBS Planning (continued)

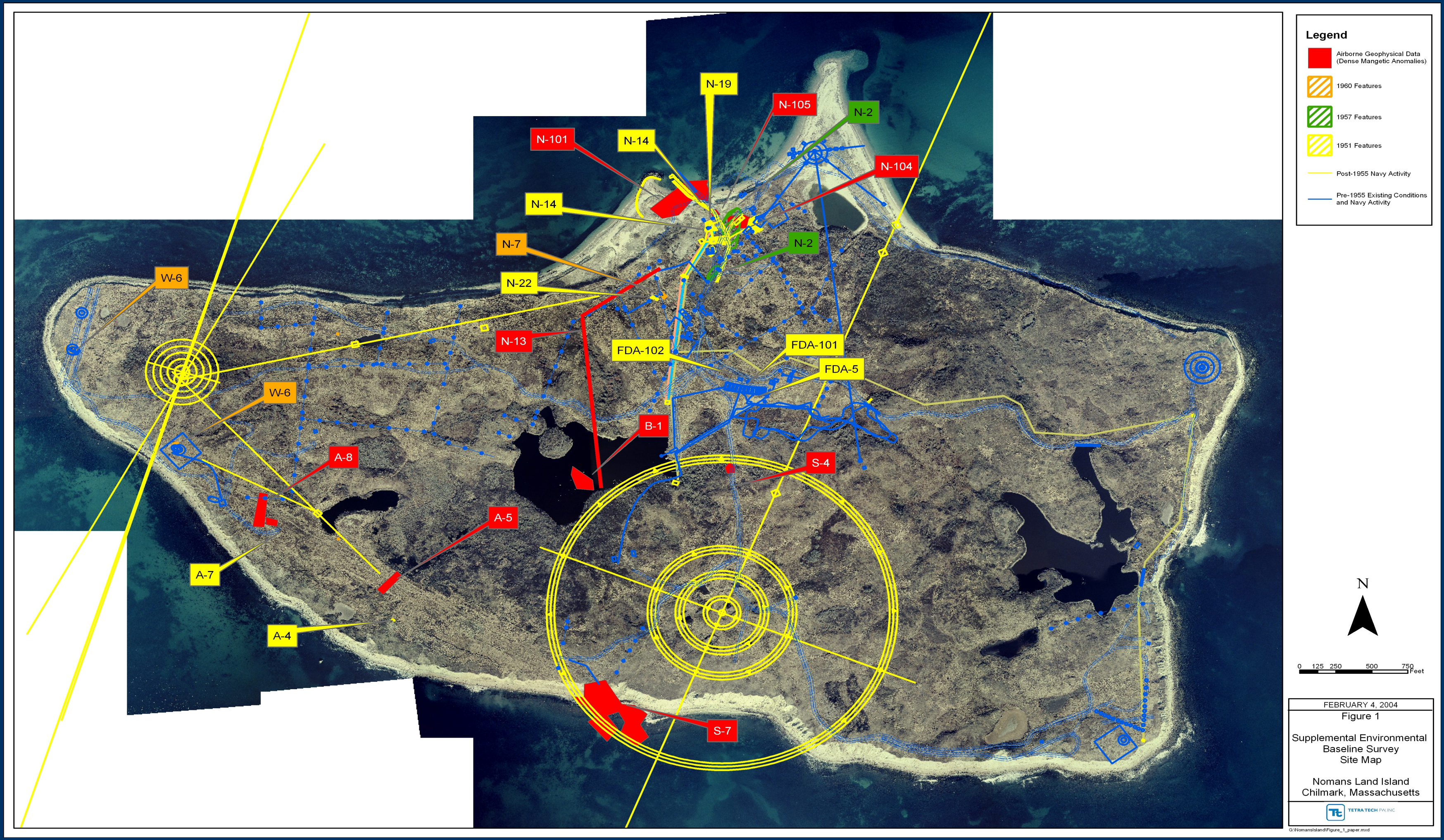
- 19 New Review Items

- Examples
  - USTs
  - ASTs
  - former storage pads
  - septic systems
  - dry wells
  - stained soils
  - historical excavations
  - other potential less-impacted target areas

- Review Items were addressed in two ways

  - those requiring initial investigation/assessment - SEBS Scope of Work (SOW)
  - those requiring excavation and potential remediation - Release Abatement Measure (RAM)

SEBS Planning (continued)


N-19
N-105
N-2
N-101
N-14
N-104
N-14
N-2
N-7
W-6
N-22
N-13
FDA-102
FDA-101
FDA-5
W-6
B-1
A-8
S-4
A-5
A-7
A-4
S-7
Legend
🟥 Airborne Geophysical Data (Dense Mangetic Anomalies)
▨ 1960 Features
▨ 1957 Features
▨ 1951 Features
Post-1955 Navy Activity
Pre-1955 Existing Conditions and Navy Activity
N
0 125 250 500 750 Feet

FEBRUARY 4, 2004

Figure 1

Supplemental Environmental
Baseline Survey
Site Map

Nomans Land Island
Chilmark, Massachusetts

TETRA TECH FW, INC.

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SEBS Program - Field

- **needed a way to locate, delineate, investigate, assess, survey, and document the chosen Review Items……**

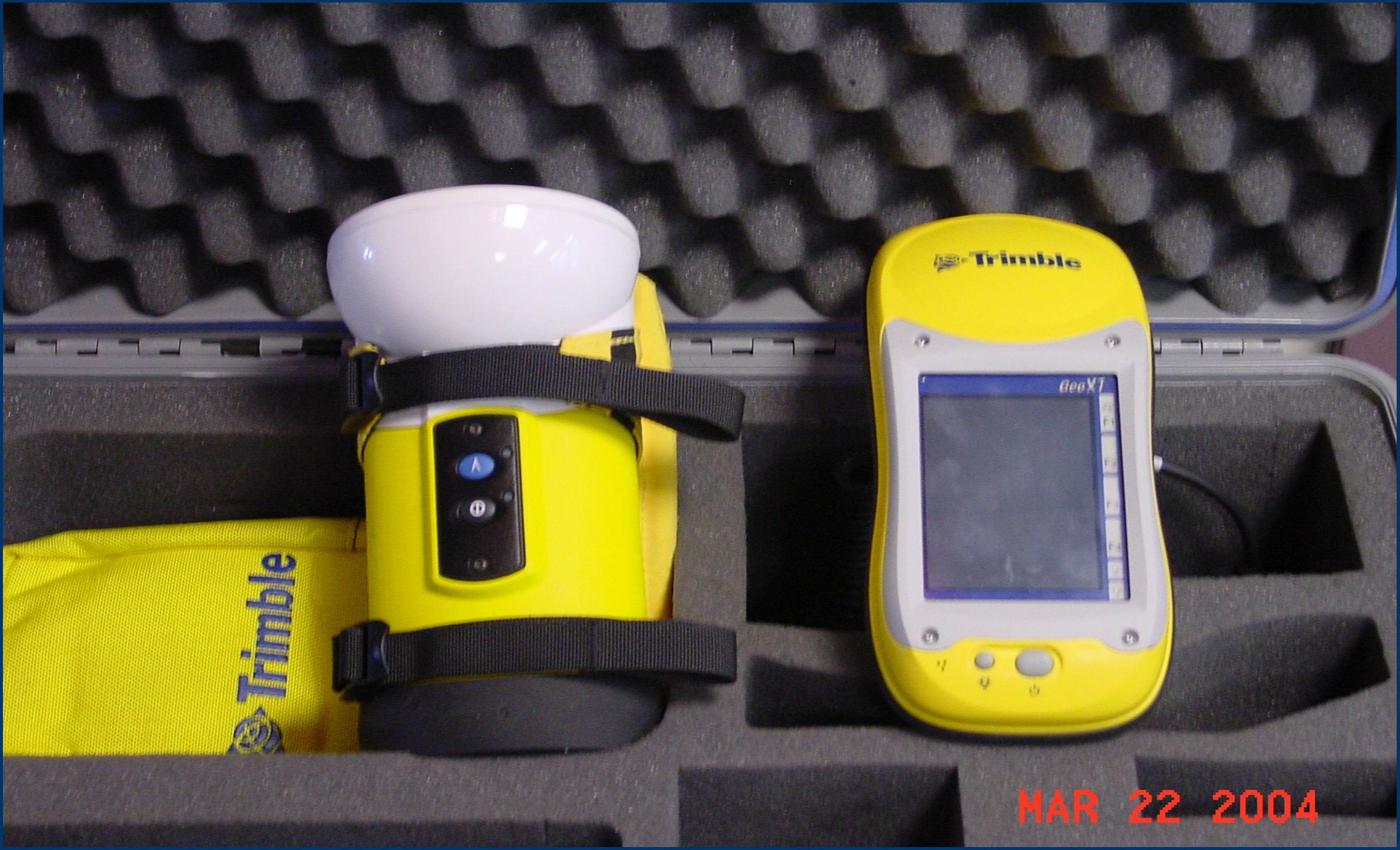
- **Field GIS/GPS System**

HARDWEAR
  - **Trimble GeoXT - WAAS Enabled**
  - **Trimble Beacon-on-a belt - Real-time radio link**
  - **standard field laptop**
  - **custom external power supply for remote site**

SOFTWARE
  - **Trimble Terra-Sync firmware**
  - **Trimble Pathfinder Pro**

GIS LAYERS
  - **Aerial Photogramatic Base Map**
  - **Aerial Geophysical Data**
  - **Historical Design Drawings - lines, points, polygons**
  - **areas of additional investigation and sampling**

Field GIS/GPS System


Trimble
Trimble
GeoXT
MAR 22 2004

SEBS Program - Field (continued)

FIELD LOCATING

- simply upload appropriate GIS Layers for the given Review Item, obtain adequate GPS signal, and navigate to location
- Field GIS/GPS system acts as a means of UXO avoidance (magnetics data)

FIELD DELINEATION

- the System will show the user’s position over the Review Item’s layers
- Ex: a polygon which surrounds an investigation area can be “walked” in real-time

INVESTIGATION/ASSESSMENT

- custom menus and drop-down electronic forms can be established

SEBS Program - Field (continued)

- **FINAL SURVEY**
- GPS enables final survey of the position of the area (point, line, polygon) along with the item’s attribute information
- sub-meter accurate
- **DOCUMENTATION**
- electronic forms and maps document work-performed
- can be exported as spreadsheet files, JPEGS, etc
- can be printed or e-mailed and sent to client to show in-field progress

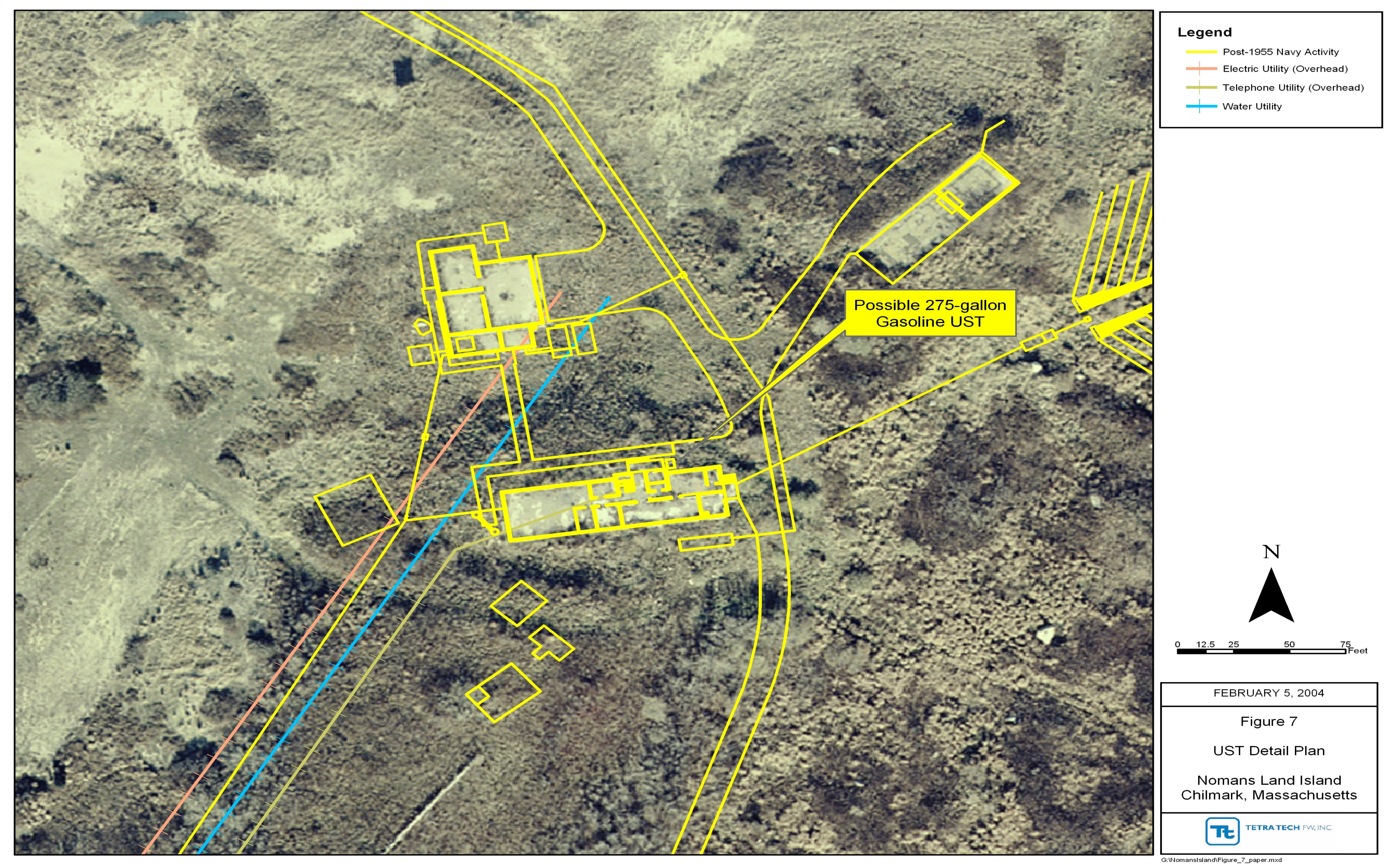
Case 1
Former Personnel Building UST

- SEBS Find

- Feature Identification
  - digitized from 1955 design drawing
  - the actual building foundation masked the magnetics data from the aerial geophysical survey
  - design drawings said it was there..but they were not “as-builts”

- Environmental Screening
  - if the UST existed.... there was the potential for a release of OHM
  - if UST existed, it was the only one not removed in 1998

Case 1 (continued)
Former Personnel Building UST


Legend
Post-1955 Navy Activity
Electric Utility (Overhead)
Telephone Utility (Overhead)
Water Utility
Possible 275-gallon Gasoline UST
N
0 12.5 25 50 75 Feet
FEBRUARY 5, 2004
Figure 7
UST Detail Plan
Nomans Land Island
Chilmark, Massachusetts
TETRA TECH FW, INC
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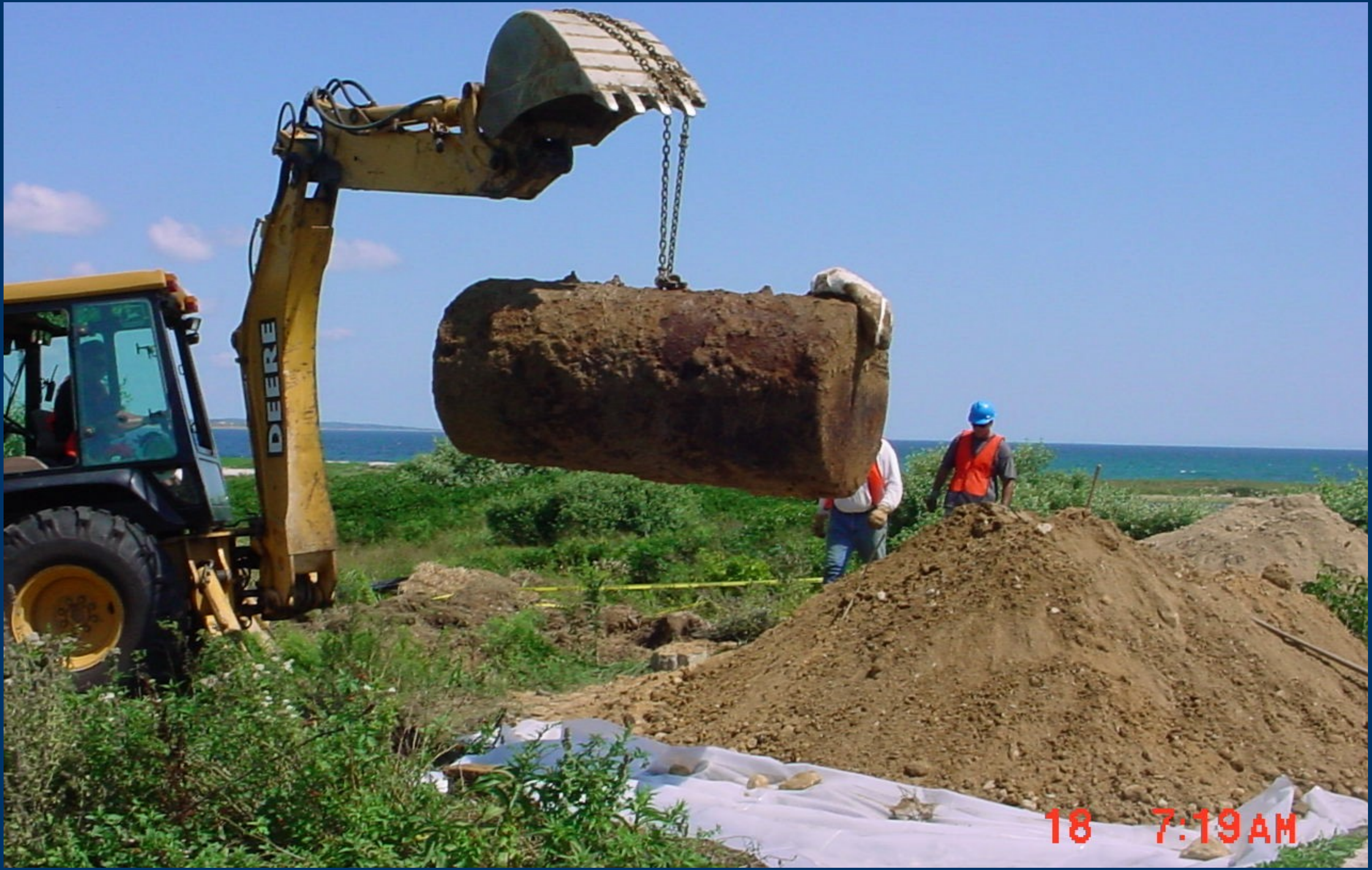
Case 1 (continued)
Former Personnel Building UST

Case 1 (continued)
Former Personnel Building UST


DEERE
18 7:19AM

Case 2

Former Quonset Hut AST

- **SEBS FIND**

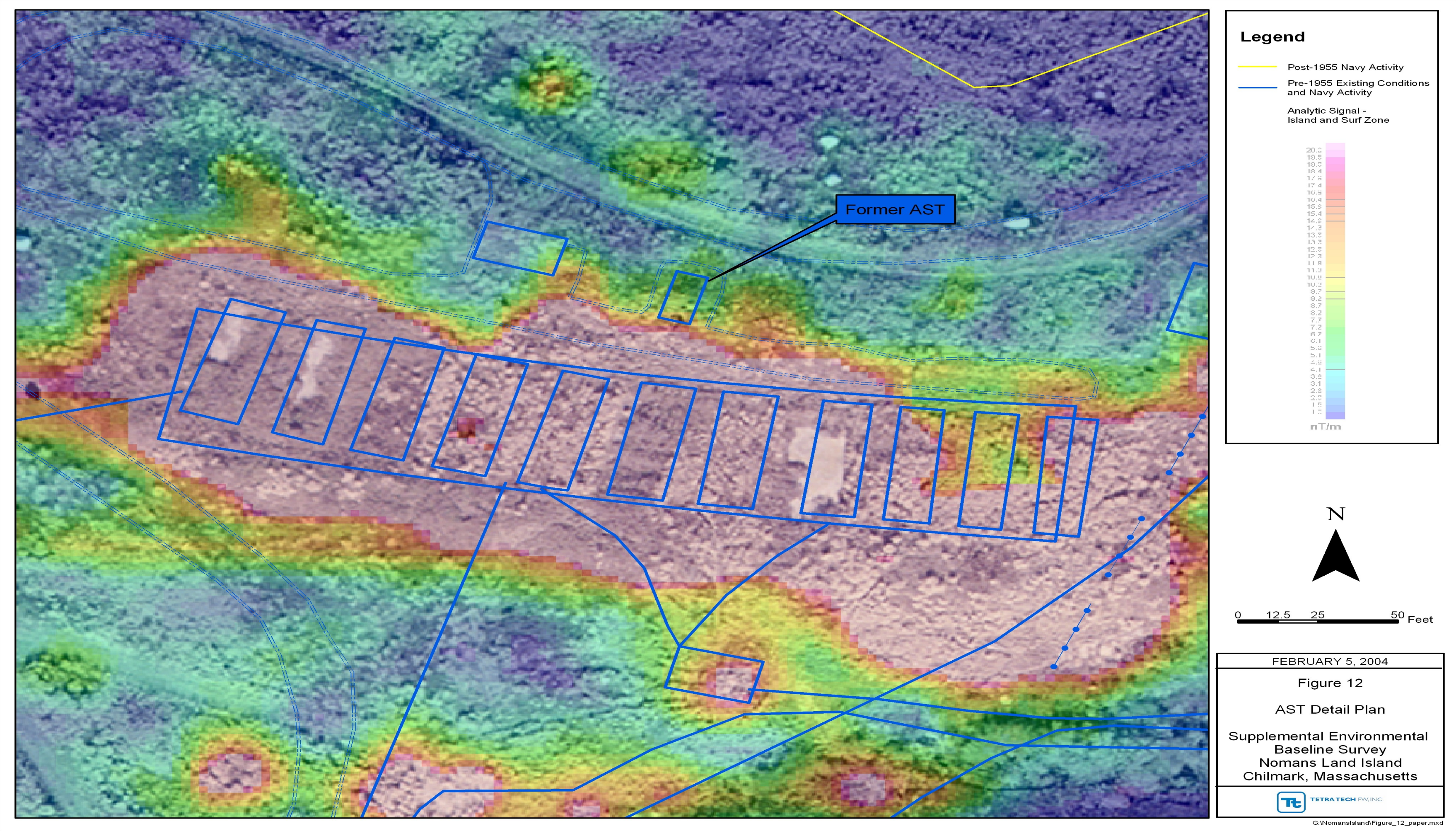
- **Feature Identification**

  - **digitized from a 1949 historical design drawing**
  - **also identified from a 1945 aerial photograph during the aerial photographic site analysis**
  - **AST appeared to support the former Quonset Huts**

- **Environmental Screening**

  - **evidence showed that the AST existed**
  - **there was the potential for a release of OHM of the years**

Case 2 (continued)
Former Quonset Hut AST


Former AST
Legend
Post-1955 Navy Activity
Pre-1955 Existing Conditions and Navy Activity
Analytic Signal - Island and Surf Zone
20.0
19.5
19.0
18.4
17.9
17.4
16.9
16.4
15.9
15.4
14.9
14.3
13.8
13.3
12.8
12.3
11.8
11.3
10.8
10.3
9.7
9.2
8.7
8.2
7.7
7.2
6.7
6.1
5.6
5.1
4.6
4.1
3.6
3.1
2.6
2.0
1.5
1.0
nT/m
N
0
12.5
25
50
Feet
TETRA TECH FW, INC.

FEBRUARY 5, 2004

Figure 12

AST Detail Plan

Supplemental Environmental
Baseline Survey
Nomans Land Island
Chilmark, Massachusetts

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Case 2 (continued)
Former Quonset Hut AST

TETRA TECH FW, INC.

Case 2 (continued)
Former Quonset Hut AST

Case 3
Former Quonset Hut Septic System

- **SEBS FIND**

- **Feature Identification**

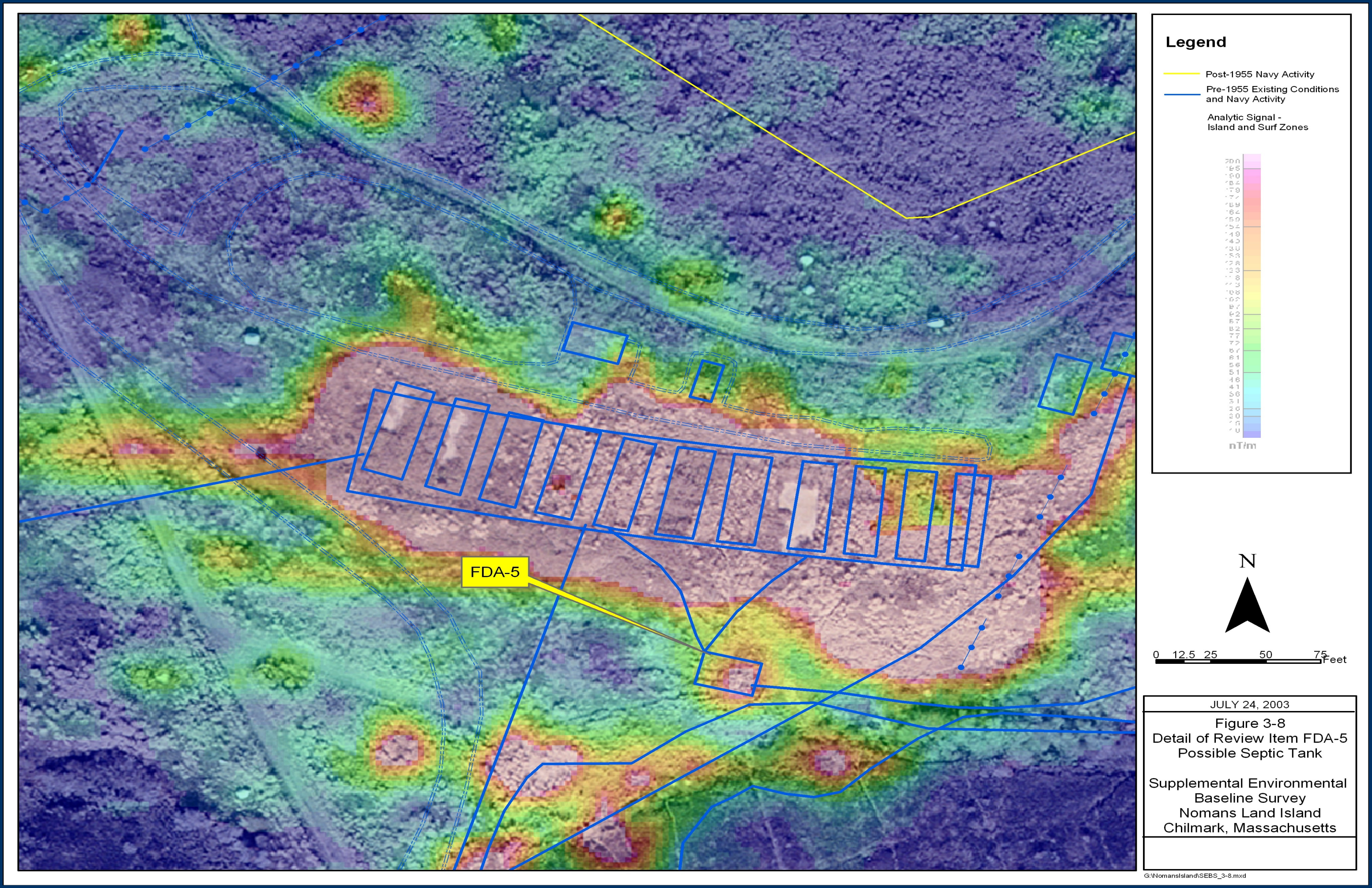
  - **digitized from a 1949 historical design drawing**
  - **after digitizing and geo-referencing the possible septic tank overlaid directly on top of a large amplitude isolated anomaly shown within the Airborne Geophysical Data layer**

- **Environmental Screening**

  - **evidence showed that the septic system may exist**
  - **there was the potential for a release of OHM due to known historical disposal practices involving septic systems…**

    - **solvents, paints, petroleum products, pesticides etc. disposal**

Case 3 (continued)
Former Quonset Hut Septic System


FDA-5
Legend
Post-1955 Navy Activity
Pre-1955 Existing Conditions and Navy Activity
Analytic Signal - Island and Surf Zones
nT/m
N
0 12.5 25 50 75 Feet
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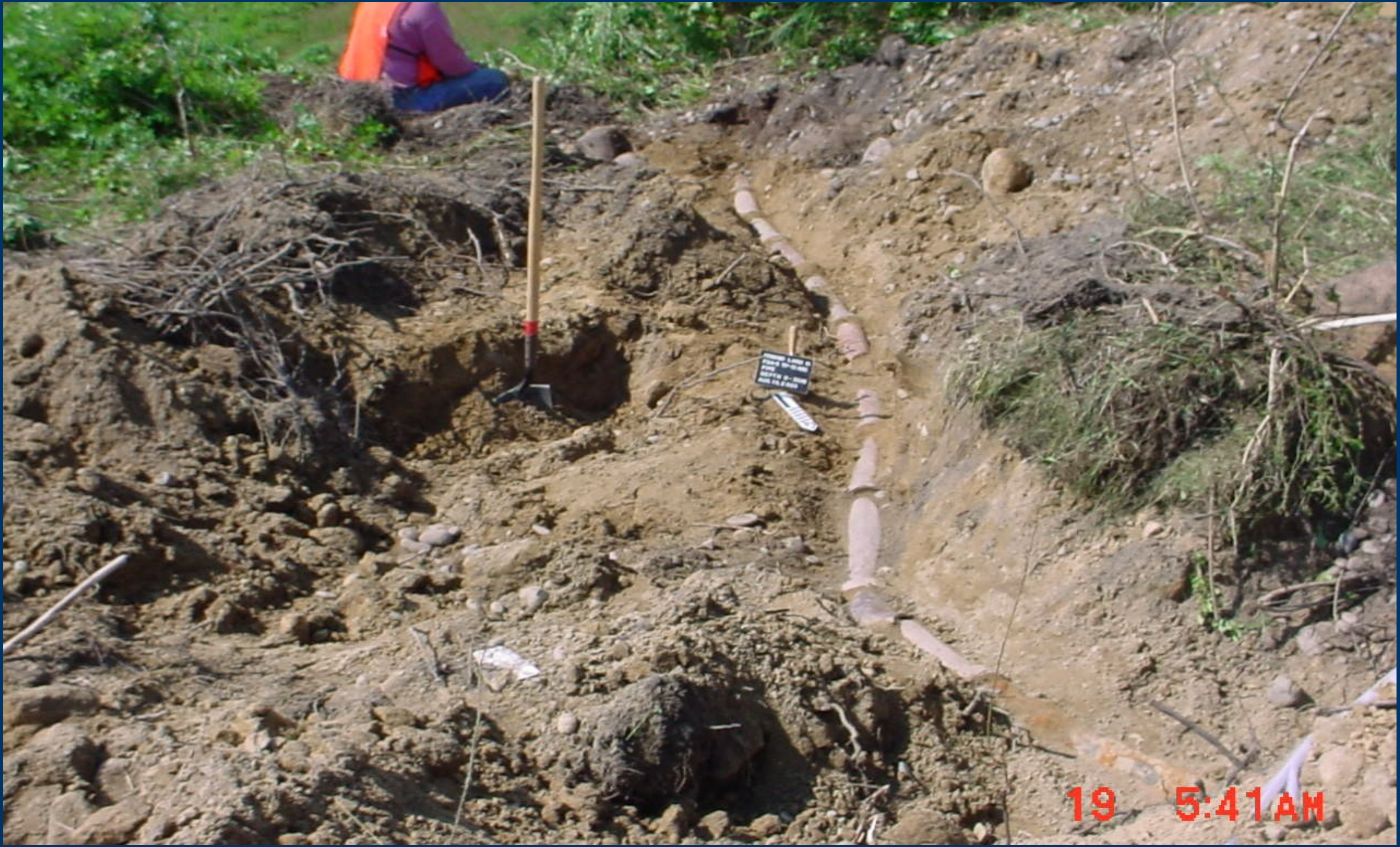
JULY 24, 2003

Figure 3-8
Detail of Review Item FDA-5
Possible Septic Tank

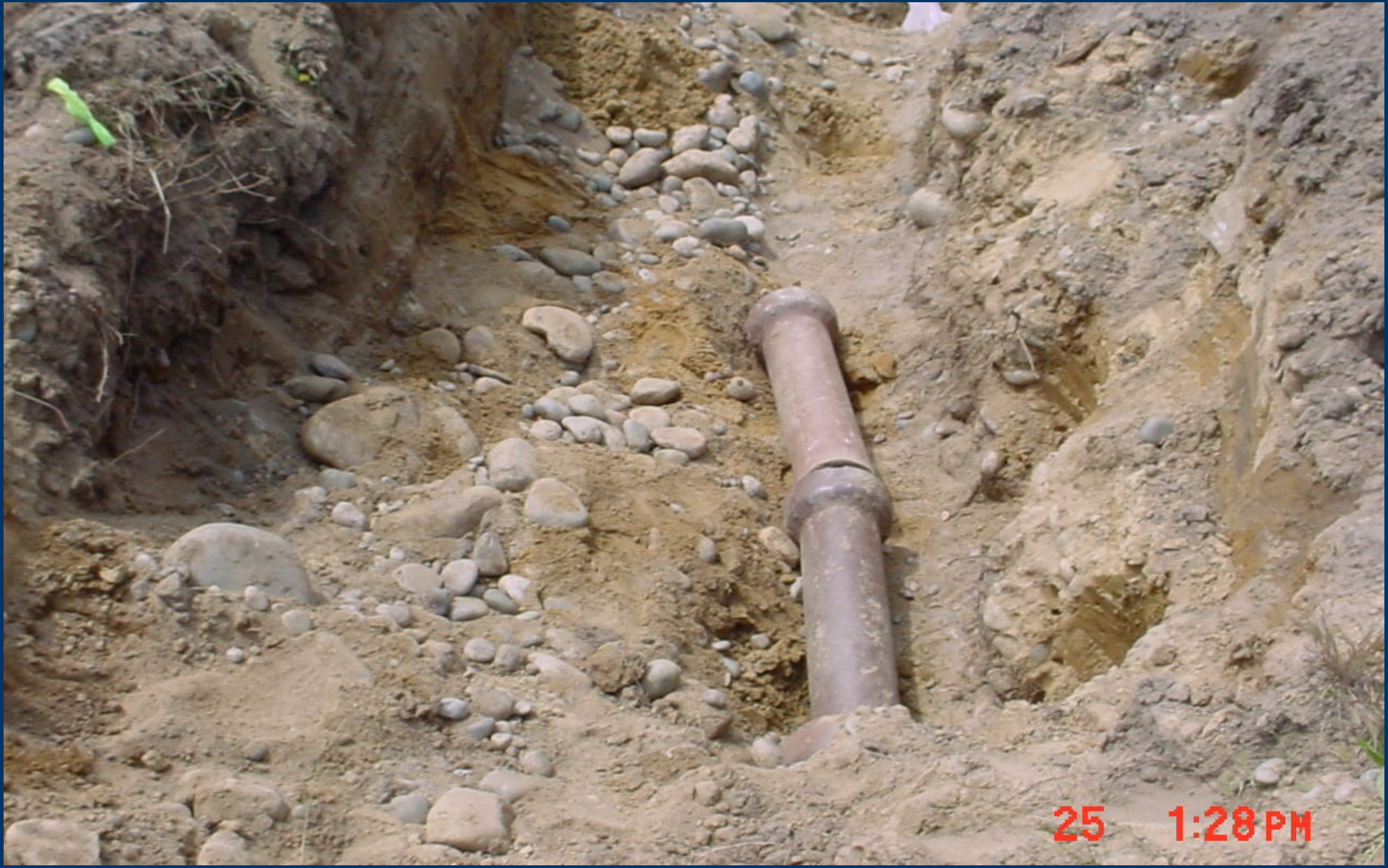
Supplemental Environmental
Baseline Survey
Nomans Land Island
Chilmark, Massachusetts

TETRA TECH FW, INC.

Case 3 (continued)
Former Quonset Hut Septic System



Case 3 (continued)
Former Quonset Hut Septic System



Case 4
Anomaly Investigation

- MADEP requested to add additional areas for sampling and investigation to the SEBS Scope of Work.

- one additional area was a large amplitude isolated anomaly upgradient of a freshwater pond

- objective

  - locate, delineate, and identify the anomaly
  - install 3 groundwater monitoring wells (1 up-gradient, 2 down-gradient)
  - this will provide chemical data to determine of the anomaly (possible MEC) adversely effects the surrounding media though leaching of possible PP metals, explosives, perchlorate

Case 4 (continued)
Anomaly Investigation

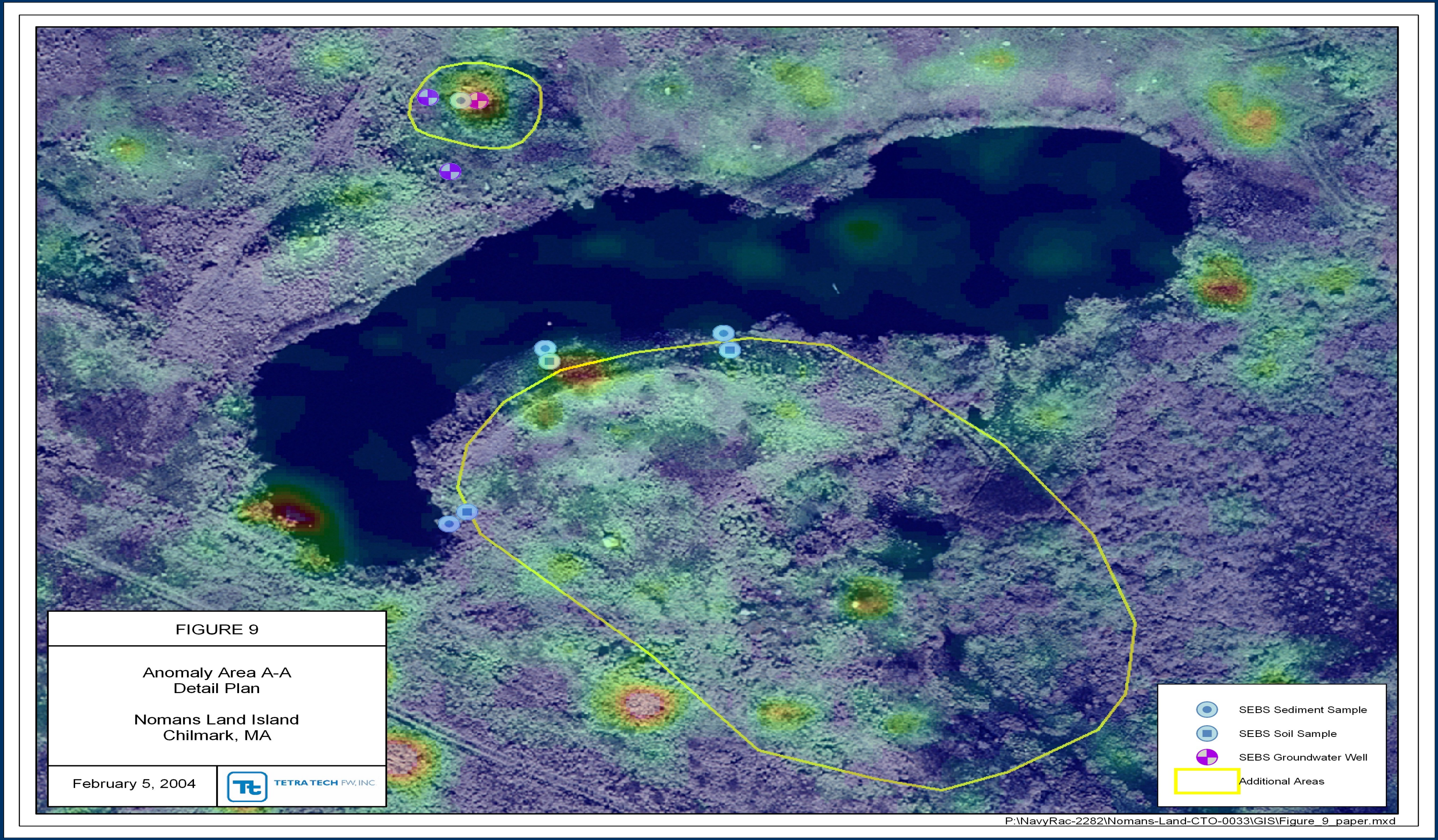
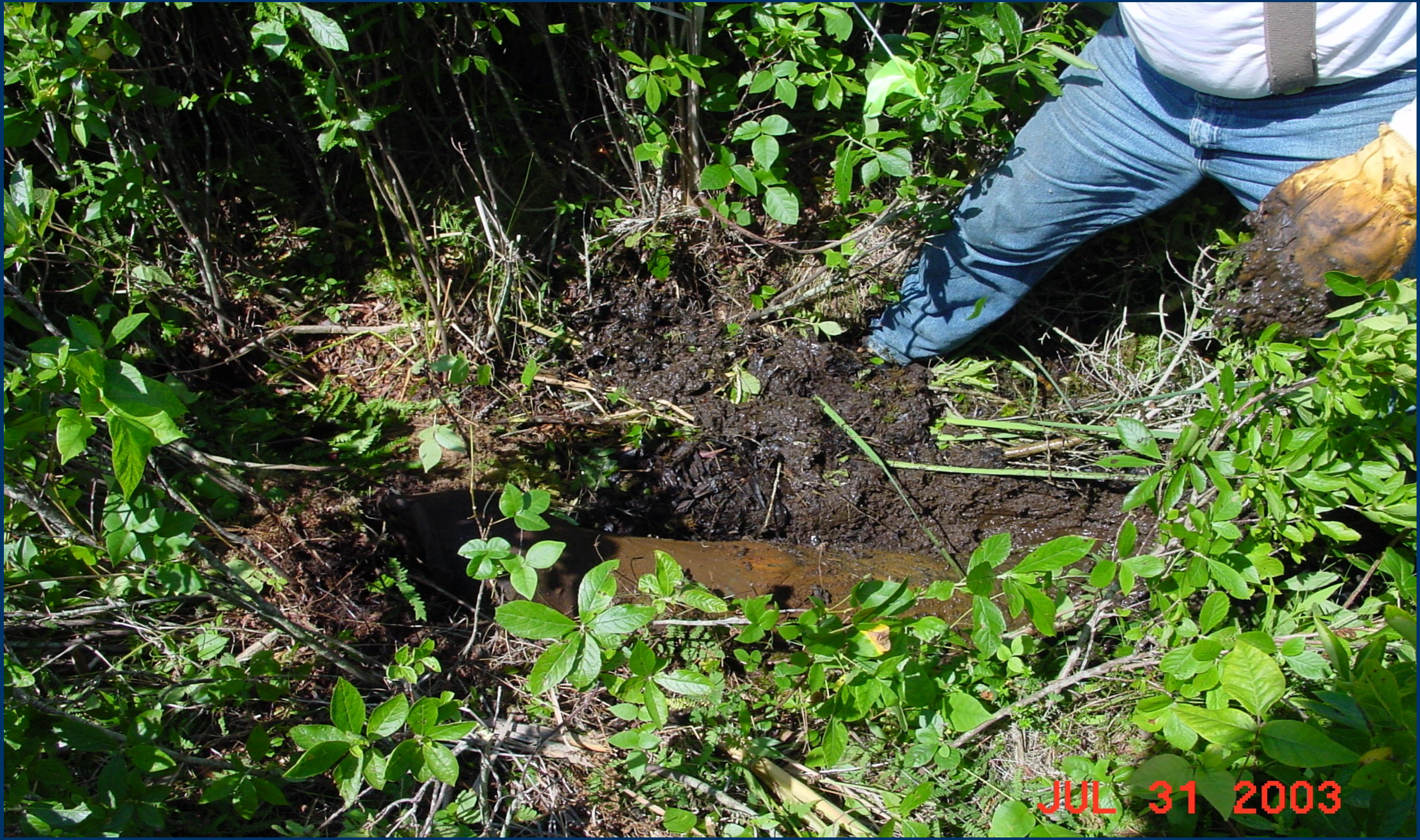
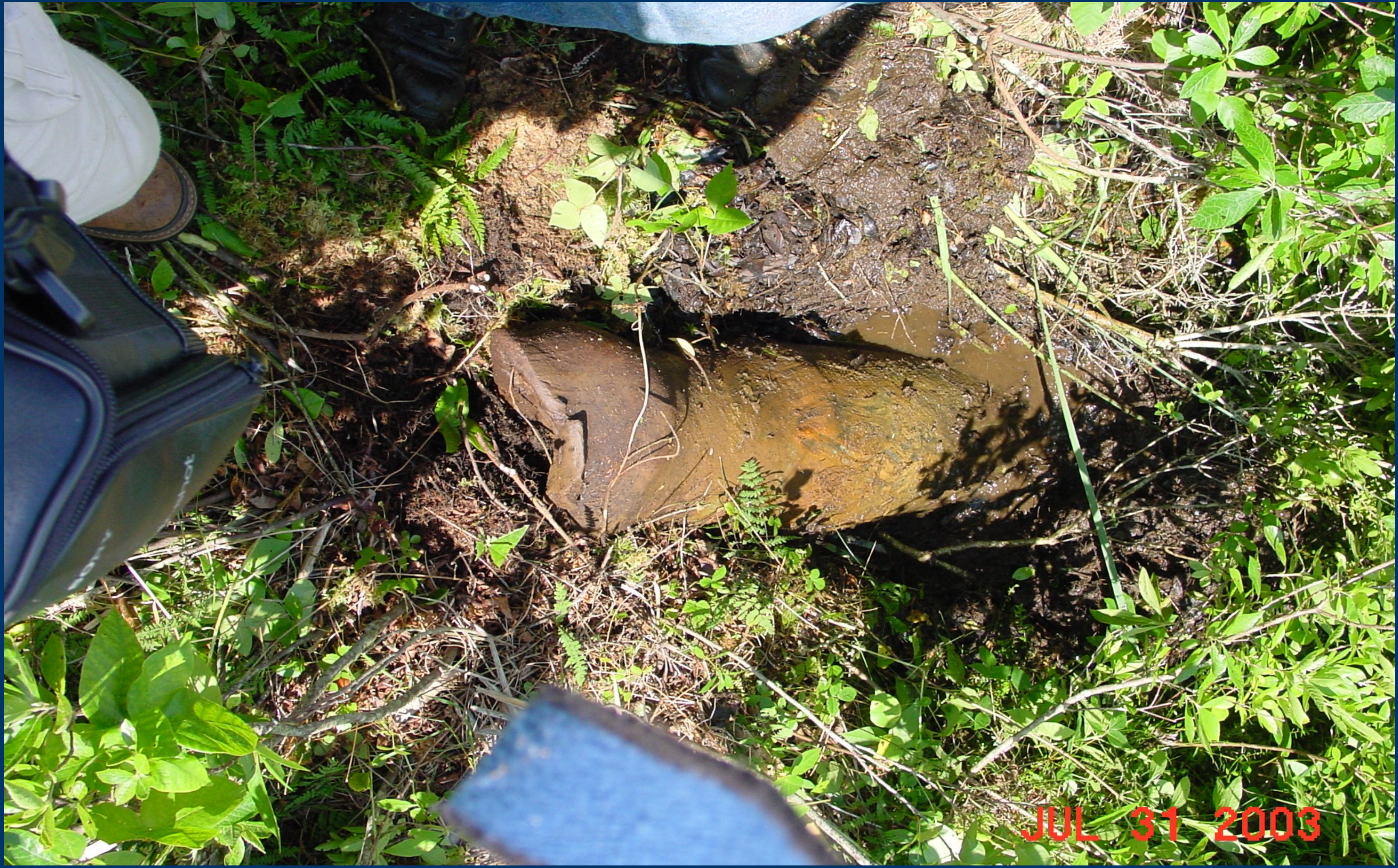


FIGURE 9
Anomaly Area A-A
Detail Plan
Nomans Land Island
Chilmark, MA
February 5, 2004
TETRA TECH FW, INC
SEBS Sediment Sample
SEBS Soil Sample
SEBS Groundwater Well
Additional Areas
P:\NavyRac-2282\Nomans-Land-CTO-0033\GIS\Figure_9_paper.mxd

Case 4 (continued)
Anomaly Investigation



Case 4 (continued)
Anomaly Investigation



Benefits/Limitations

SEBS Program Benefits

- compiled all new data sources in one concise document
- allowed technical material to be easily presented to the TRC and public
- provided components to build an extensive GIS

SEBS Program Limitations

- requires a site-specific cost-benefit-analysis to determine if this level of investigation and assessment is necessary
- some of the data was not able to be utilized within the GIS (I.e. Archive Search Report, public interviews, etc.)

Benefits/Limitations (continued)

Field GIS/GPS System Benefits

- **ruggedized unit allowed the project’s GIS to be carried into the field and utilized in heavy weather and remote conditions**

- **allowed for real-time locating of Review Items which may not have been found otherwise, due to dense vegetation**

- **digital data collection is more time and cost-effective and reduces error associated with input of data on hand-written forms**

- **allowed data to be recorded and documented for easy input for report preparation**

Benefits/Limitations (continued)

Field GIS/GPS System Limitations

- as with any system based on real-time DGPS technology, satellite signal and real-time radio availability are limiting factors (dense canopy, terrain)
- power source must be adequate for specific site conditions
- raster and vector data sources require large amounts of hard drive and RAM space to run efficiently
- add on the electronic forms, database files, survey files etc. and the system could have the risk of crashing resulting in data loss

Nomans Land Island in 3D